Tank Storage of Volatile Organic Liquids Pollution Prevention Opportunities

Storage Tanks

Bulk storage of volatile organic liquids consists of aboveground vertical cylindrical tanks with various roof configurations, aboveground horizontal tanks and underground storage tanks. Some of these tanks are pressure vessels. A pressure vessel is usually considered a closed container of a fluid under pressure used to preform some process function

Pollution Prevention Considerations

Pollution prevention opportunities for tank storage are available to minimize or eliminate volatile organic compound (VOC) emissions from storage tanks and vessels.

The decision of which and how many of these opportunities to use (i.e. how far to move toward a zero waste and emissions design) will depend on a number of factors including:

- Business environmental goals
- Economics
- Applicable regulations

Reducing Emissions

Pollution prevention opportunities for tank storage of volatile organic liquids include the following categories:

1. Source reduction of breathing losses
2. Source reduction of working losses
3. Other source reduction approaches

Source Reduction of Breathing Losses

Breathing loss is the expulsion of vapor from a tank vapor space that has expanded due to daily changes in temperature and barometric pressure. Source reduction steps may reduce breathing losses between 10 percent and 95 percent. These steps may be considered even when an end-of pipe treatment device will be installed, to help reduce the size and or cost of the treatment unit.

<u>Reduce the vapor space in the tank</u>

A large fraction of the breathing losses are caused by thermal expansion of the VOC-laden vapor in the tank head space. Reduction of the tank head space may be accomplished by:

1. Operating at a constant level (fill rate = withdrawal rate).
2. Use a variable vapor space tank.
3. Operate 5 tanks completely full rather than 10 tanks half full.
4. Others (bladders, floating balls, etc)

Addition of inert gasses

Eliminate, whenever possible, continuous nitrogen addition for padding. Consider a design based on pressure control rather than flow control. If continuous addition is necessary, use a rotameter or other flow control device.

Keep the tank at constant temperature

Options include painting the tank white to reflect more sunlight, insulating the tank to reduce heat transfer between the tank contents and the surrounding air, and operating the tank at a constant temperature with supplemental cooling and or heating. The heating/cooling option, in particular, would need an economic feasibility evaluation.

Raise the vent temperature

Examine the possibility of raising the pressure at which the conservation vent opens, to reduce emissions caused by thermal expansion of the tank vapor space. However, do not exceed the tank design pressure. Tanks which operate at 2 ½ psig or higher will often have little or no breathing loss.

Source Reduction of Working Losses

Working losses result from filling and emptying operations. Source reduction steps may reduce working losses between 10 percent and 95 percent. One of these steps may be considered even when an end-of-pipe treatment device will be installed to help reduce the size and/or cost of the treatment unit.

Vapor Balancing

Consider installing vapor return lines to send the displaced vapor from the tank being filled back to the liquid source (e.g. tank truck). This approach is used at gasoline stations during Stage I (vapor balancing between unloading tank truck and underground storage tank) and Stage II vapor recovery (vapor balancing between car gas tank and underground storage tank). Eventually, however, the displaced vapor will have to be treated. In the case of gasoline stations, this occurs at the tank truck loading terminal. A corollary approach would be to equalize the vapor space between tanks in a tank farm using a common vent header. This would apply to tanks containing the same solvent or where cross- contamination is acceptable. Vapor displaced while filling one tank would fill the vapor space of a tank being emptied. When considering vapor balancing techniques, vent header safety must be addressed to avoid creating a situation where fire could propagate between tanks.

Maintain Constant Tank Level

If the fill rate equals the withdrawal rate, working losses are eliminated.

Reduce the Number of Tank Turnovers

The annual number of tank turnovers (tank volumes/yr) is equivalent to the annual solvent consumption (gal/yr) divided by the liquid storage volume of the tank (gal/tank). For a fixed tank volume, reducing the number of tank turnovers per year will reduce emissions. In addition, the less frequently a tank is "turned over," the less likely the tank vapor space will be saturated by the VOC.

Other Source Reduction Approaches
Some source reduction options can reduce both breathing and working losses.

Eliminate the Tank

Consider just-in-time delivery from a tank car or tank truck.

Alternate Solvent

Particularly in the design of new processes, it may be feasible to choose a solvent with a lower vapor pressure.

Other Approaches

Install a gas holder (variable vapor space tank) to contain displaced vapor during filling and thermal outbreathing. The vapor from the gas holder can then be returned to the liquid storage tank during emptying and inbreathing.

Another option is to place Styrofoam balls or a fabric cover over the liquid surface to minimize evaporation. This has had some negative reviews however. A third approach is to place an expandable bag or bladder inside the tank to contain the vapor; however bag tears would be difficult to detect, particularly in large tanks.

Liquid Storage Example Study
A new manufacturing facility will use 10,000 gallon pressure vessels to store a volatile organic raw material instead of low-pressure tanks with conservation vents. The air permit for the new facility limits VOC emissions to less than 5 tons per year (including fugitives). Storage tanks at the existing manufacturing facilities are designed for 5 psig and are operated with conservation vents. The tanks are purged with nitrogen to exclude oxygen from the tank vapor space and use nitrogen-purged level indicators.

The new tanks will be designed for 100 psig, use diaphragm level indicators, add nitrogen to maintain a minimum pressure of 0.5 psig during liquid withdrawal and vent at pressure to a -40C refrigerated vent condenser followed by a headered flare. Recovery of 75 percent is expected in the vent condenser with the flare destroying 98 percent of the remaining VOC emissions. Other options that were considered included floating roofs and venting to a water scrubber followed by biotreatment of the aqueous waste stream.

Help Estimating Tank VOC Emissions

EPA's "Tanks" software computes estimates of voc emissions from fixed and floating-roof storage tanks. The free software can be downloaded at internet site:
http://www.epa.gov/ttn/chief/tanks.html